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PHARMACOGNOSTICAL STUDIES ON *JIVANTI*
PART I—*DESMOTRICHUM FIMBRIATUM* BLUME

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ABSTRACT

The present paper deals with the macro- and the microscopical studies of all vegetative parts of *Desmotrichum fimbriatum* Bl. alongwith fluorescence characters and physical constants of the drug.

INTRODUCTION

Jivanti is a reputed Ayurvedic drug, used for different ailments, in the indigenous system of medicine but its correct identity is still a disputed problem. There are three different species, namely *Desmotrichum fimbriatum* Bl. (*Dendrobium macrei* Lindl. Fam. Orchidaceae), *Leptadenia reticulata* Wight and Arn. (Fam. Asclepiadaceae) and *Trema orientalis* Bl. (*Celtis orientalis* Linn. Fam. Urticaceae), described in literatures as *Jivanti* (*Kirtikar* and *Basu,* 1933 ; *Chopra et al.,* 1956). Although most of the books on indigenous drugs have described *Desmotrichum fimbriatum* as *Jivanti* but some of the authorities in the field described *Leptadenia reticulata* as real *Jivanti* (*Sharma,* 1956).

Desmotrichum fimbriatum Bl. (*Dendrobium macrei* Lindl.) is an epiphytic orchid distributed in South-East Asia. It occurs in Sikkim, Khasia Hills and Western Ghats and Nilgiri Hills upto an altitude of 8000 ft. It has a creeping rhizome, smooth pendulous stems and white or pinkish red speckled flowers. The drug is described as cooling, mucilaginous, light, strengthening and *tridoshagna* (curer of the disorders—vata, pitta and kapha). It is used as a tonic in debility due to seminal discharges. The whole plant is used in decoction along with other drugs having similar properties. It is also used as an alterative, astringent to the bowls, expectorant and useful in asthma, bronchitis and throat trouble (*Anonymous,* 1952 ; *Kirtikar* and *Basu,* 1933 ; *Chopra et al.,* 1958 ; *Nadkarni,* 1954).

The drug has been the subject of some phytochemical investigations. The earliest observation was made by Dymock *et al.* (1893), who reported the presence of traces of an alkaloid, α and β-Jivantic acids from the stem and the root of the plant. Similar findings were also reported by others (*Chopra et al.,* 1958 ; *Nadkarni,* 1954). In the pharmacognostical field, no work is on record excepting the morphological characters of the drug (*Anonymous,* 1952 ; *Kirtikar* and *Basu,* 1933).

In view of the importance of the drug in the indigenous system of medicine, it was deemed desirable to undertake a detailed investigation on this aspect. In the present investigation detailed macro- and microscopical studies have been made on the root, stem-creeping and aerial, pseudobulb and the leaf of the plant. Recourse was also taken to investigate the fluorescence characteristics of the powder of the whole plant, to clearly elucidate the diagnostic characters of the drug.

MATERIAL AND METHODS

Dry specimens of the whole plant of *Desmotrichum fimbriatum* was obtained from different markets compared with the authentic sample and were found to be genuine. After softening the material, free-hand and microtome sections were taken, stained and mounted. The cell contents and cell-wall structures were studied (*Johansen,* 1940 ; *Kay,* 1938). Fluorescence character exhibited by the powder of the whole plant were noted according to the methods of Chase and Pratt (1949). For the study of the structure of isolated elements, small pieces of different parts of the plant were separately macerated in Schultz's fluid, washed with water, teased and mounted in glycerine. The quantitative values of the leaves were also determined according to the method described by Wallis (1948). The total and acid insoluble ash, alcohol and water soluble extractives were determined as given in I.P. (*Anonymous,* 1966).

MACROSCOPICAL CHARACTERS (Fig. 1)

Root: The plant bears two types of roots: clinging and aerial. The clinging roots are small whitish grey in colour, flat on the side attached with support, with no characteristic fragrance. The aerial roots are adventitious, long, measuring 3-20 cm, piercing the scaly leaves, diverge from the lateral and ventral portions of the basal nodes of the branch. The apical portion of the root tapers abruptly, pale yellowish in colour, with a white covering of velamen. If root tip dies 3-4 lateral roots may, however, develop. Sometimes branching of root may be marked even without degeneration of the tip. There is no characteristic odour and taste.

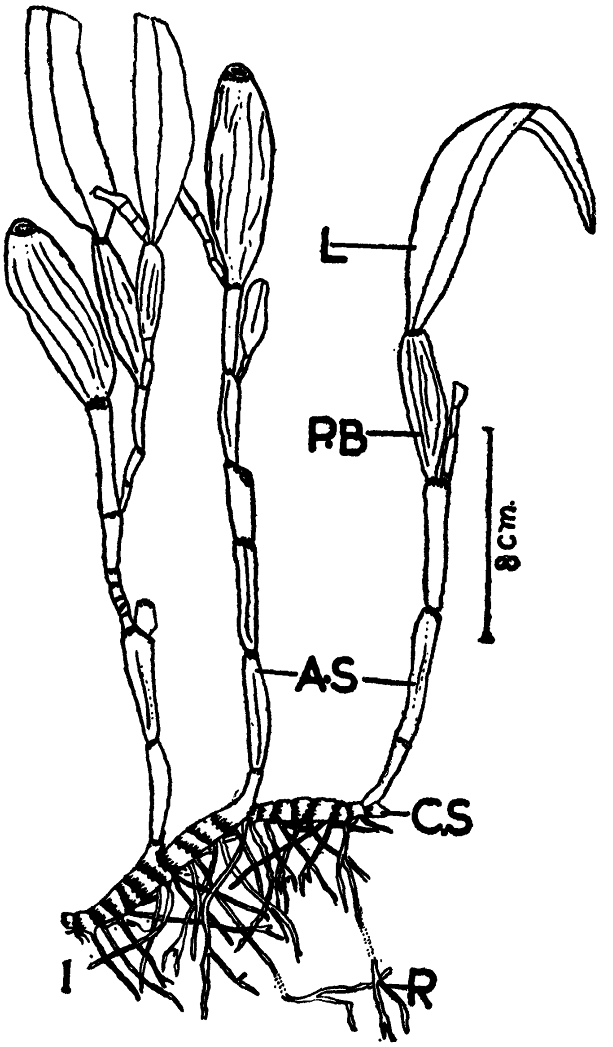


Fig. 1 : Macroscopical characters of *Desmotrichum fimbriatum* Bl. A.S, aerial stem ; C.S, creeping stem ; L, leaf ; P.B, pseudobulb ; R, root.

Creeping stem: The creeping stem is brownish in colour with distinct nodes and internodes; obliquely grown, hairy, scaly leaves arising from each node. The distance between nodes vary from 3 to 9 mm and after 6 to 9 nodes it gives out branches of pendulous aerial stem. A number of fibrous roots arise throughout the nodes.

Aerial stem: The aerial stem is annulate and profusely branched. The branches are polygonal, more or less trigonous or terete, smooth, shining, yellowish brown, ending in pseudobulb and are 3 to 10 mm wide. The distance between two nodes varies from 4 to 40 mm. The pseudobulbs appear after 2nd to 3rd nodes and after 4th to 7th nodes. The last internode of aerial stem ends into a pseudobulb. It has no distinct taste and odour.

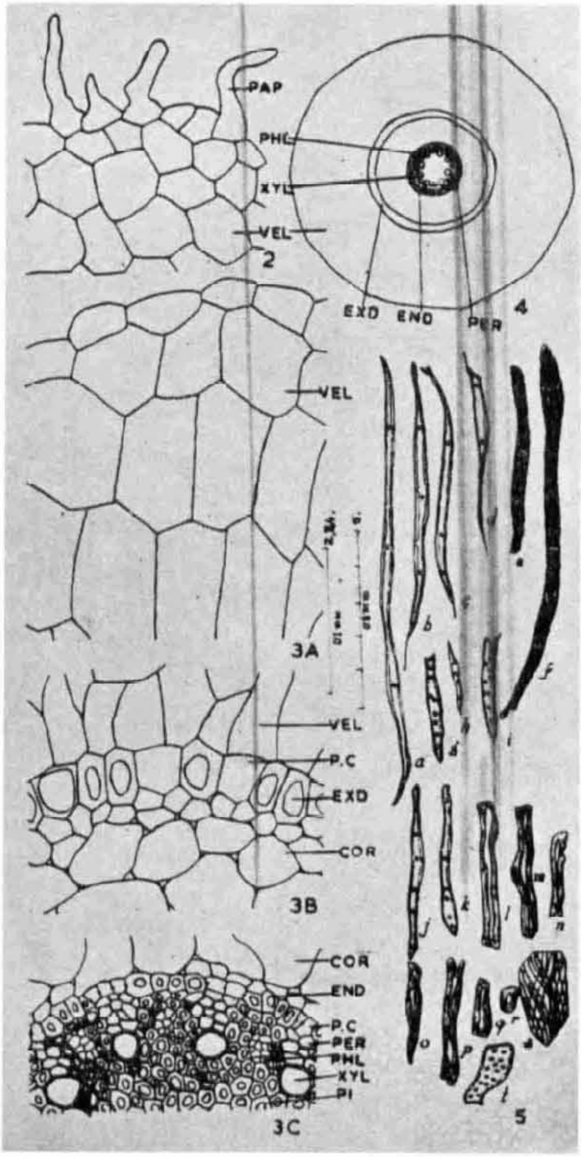
Pseudobulb: The pseudobulbs, formed of swollen and fleshy internodes, are storage of water and reserves. These are smooth, shining, somewhat compressed, narrowly fusiform. The number of the pseudobulb in each aerial stem varies from 5 to 8. They are up to 8 cm long and 2 cm wide.

Leaves: The leaves are pale yellow in colour, sessile, very coriaceous, 4 to 10 cm long and 1 to 2.5 cm broad, ovate-lanceolate or oblong-elliptical, acute, obtuse or rarely subretuse. The veins are parallel with distinct midrib. There is no characteristic odour and taste.

MICROSCOPICAL STRUCTURE (Figs. 2 to 5)

Aerial root: The transverse section of the root shows an outer tissue known as velamen (Figs. 3A-3B). It consists of 5 to 6 layers of compact cells, the walls of which are thickened by fibrous supporting ribs (Fig. 5s) arranged like net showing lignin reaction. Cells measure 20-45-62-82 by 12-29-37-54μ. Velamen is followed by cortex, the outermost layer of which, consists of a row of specialised tissue known as the exodermis (Fig. 3B), the cells of which are radially elongated, thick walled, lignified with circular striations excepting the passage cells. These cells appear like sclereid when macerated, their ends being flattened or somewhat bifurcated (Fig. 5 l-r). They measure 66-198-330-445 by 25-33-41-49μ. The rest of the cortex is composed of 4 to 5 layers of thin-walled parenchyma with small intercellular spaces and measure 12-36-53-98 by 8-20-36-90μ. The innermost layer of cortex is represented by an endodermis, the cells, measuring 24-28-41 by 21-23-25μ, are lignified except the passage cells (Fig. 3C) which are situated opposite to the protoxylem and show Casparian thickenings. Usually 1 to 3 such thin-walled passage cells are present between two lignified endodermal cells.

A single layered pericycle, composed of thin-walled cells below the passage cells and thick-walled, lignified cells below the lignified cells of the endodermis, encloses the central stele which consists of a number of phloem and xylem strands alternating radially and separated by heavily lignified fibres (Fig. 3C). The phloem strands, represented by sieve tubes, companion cells and phloem parenchyma, are completely surrounded by sclerenchymatous fibres which join the pericyclic fibres.



Figs. 2-5 : Microscopical structure of root of *Desmotrichum fimbriatum* Bl.

Fig. 2. Details of a portion of T. S. of clinging root showing papillae on outermost velamen cells. Fig. 3. A, B, C : Details of a portion of aerial root. Fig. 4. Diagrammatic T. S. of aerial root. Fig. 5. Isolated elements of the root. a-d, fibres ; e & f, vessels ; g-k, tracheids ; l-r, exodermis ; s, a single velamen cells showing net like thickening on the walls ; t, parenchyma. COR, cortex ; END, endodermis ; EXD, exodermis ; PAP, papilla ; P. C, passage cells ; PER, Pericycle ; PHL, Phloem ; PI, pith ; VEL, velamen ; XYL, xylem.

The xylem consists mostly of tracheids, fibres, a few vessels and parenchyma, all are lignified and have bordered pittings on their walls except the vessels which are scalariform or spirally thickened. Vessels are usually very long having transverse or slightly oblique articulations at the ends (Fig. 5 e-f), measuring 412-*825-1568*-1724 by 25-33-50-66μ The tracheids are short, with tapering, truncated or bifurcated ends (Fig. 5 g-k) measuring 143-250-349 by 16-25-33μ. The fibres (Fig. 5 a-d) are long having either both ends pointed or one end bifurcated. They have only a few bordered pits on their walls and measure 280-577-957 by 12-25-33μ. The pith cells are thick walled and lignified (Fig. 3C).

Clinging root: The transverse section of the clinging root (Fig. 2) shows the similar arrangement of tissue as the aerial root excepting that the cells of the outermost layer of the velamen, which are in close contact with the support, elongate and become papilae like, with the help of these outgrowths the roots get attached to supporting plant.

Creeping stem: A transverse section of the creeping stem, passing through the internode, shows a single layered epidermis (Fig. 6 and 7A), covered externally with thick cuticle. The epidermal cells are highly lignified and somewhat tangentially elongated, measuring 16-*21*-25-29 by 10-*12-14*-17μ.

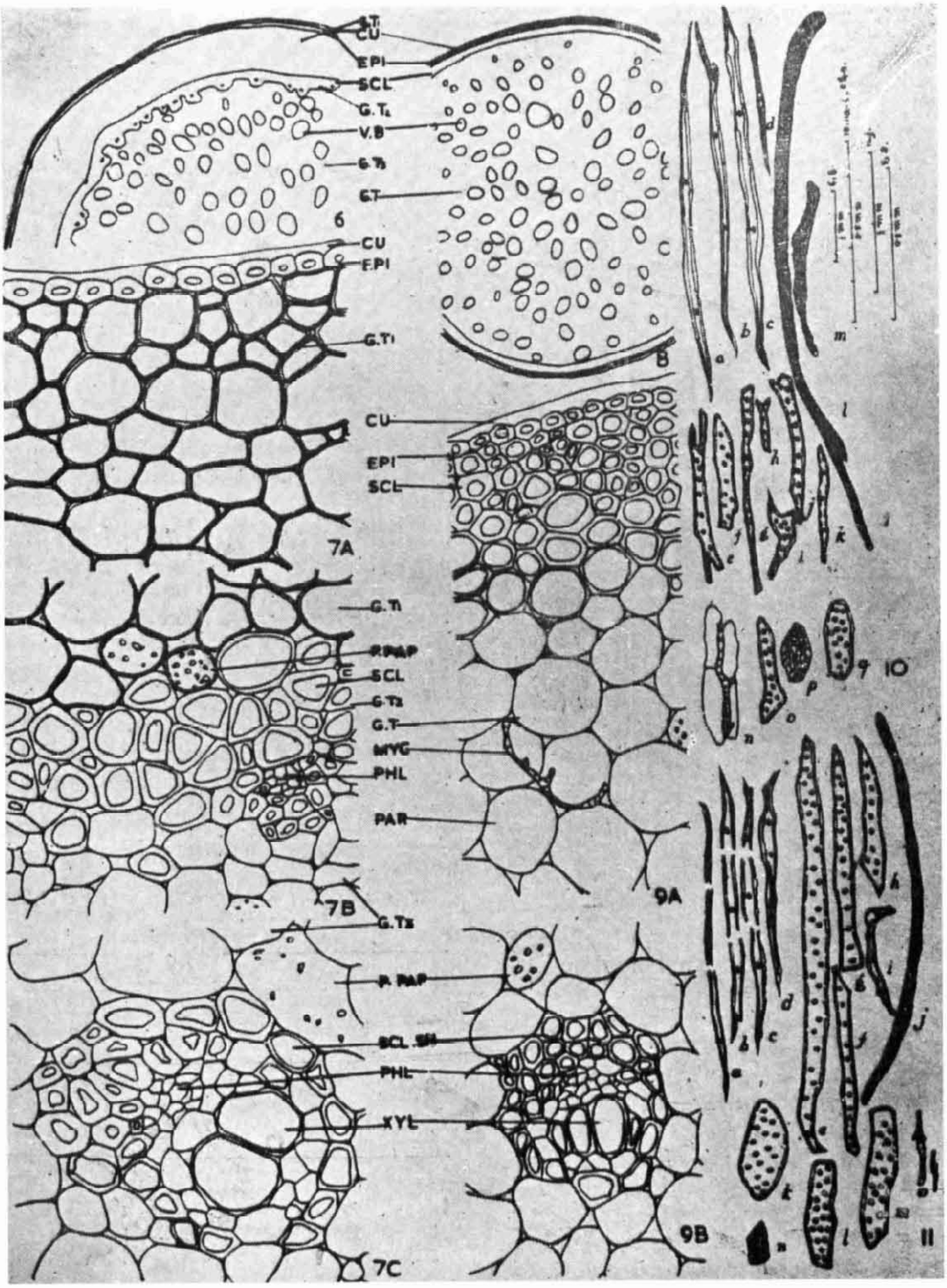
The ground tissue is differentiated into three zones (Fig. 6). The outermost zone (Fig. 7A, 7B) is devoid of vascular bundles and is composed of thick-walled, slightly lignified parenchymatous cells with small intercellular spaces. These cells are somewhat polyhedral to isodiametric which gradually become larger and circular to oval in shape and the thickening also gradually decreases towards the inner side. The cells measure 16-*45-82*-131 by 17-*29-49*-55μ The second zone (Fig. 7B) consists of 3-7 layers of sclerenchymatous fibres forming almost a continuous band having a number of vascular bundles, in which only phloem strands are distinct. embedded into it. The innermost zone of the ground tissue (Figs. 7B, 7C) is composed of thin-walled circular to oval parenchymatous cells with small intercellular spaces. A number of vascular bundles, enclosed in a bundle sheath are found scattered in this region.

The vascular bundles (Fig. 7C) are close, collateral consisting of xylem and phloem strands only. The sheathing sclerenchyma are fibrous and having a few bordered pits on their walls. The phloem is composed of usual elements. The xylem consists of vessels tracheids, fibres and parenchyma; all the elements are lignified. The vessels (Fig. 10 l, m) are long with transverse to oblique articulations at their ends, and have sclariform and spiral type of thickenings measuring 446-*825*-1650 by 25-33-60μ. Tracheids (Fig. 10 e-k) are moderately thickened having pointed, flattened and bifurcated ends having bordered pits on their walls. They measure 116-347-495-726 by 12-33-*41*-50μ. The fibres (Fig. 10 a-d) are, highly thickened with a few bordered pits on their walls, long with tapering pointed and bifurcated ends, measuring 297-*610-1089*-1402 by 8-*17*-25-33μ. The parenchyma (Fig. 10 o-q) is oval to irregular in shape with bordered to reticulate type of the thickenings. The mycorrhizae are distributed throughout the parenchymatous ground tissue (Fig. 10 n).

Aerial stem: Aerial stem, in a transverse section, shows uniseriate epidermis (Figs. 8, 9A) covered externally with a well developed cuticle. The cells are cubical to barrel shaped and are highly lignified and measure 12-*16-18*-21 by 8-*10-12*-17μ. The epidermis is followed by a band of 5-7 layers of lignified sclerenchymatous cells measuring 10-25-30-45 by 10-*21*-25-27μ. Below this band is a wide parenchymatous ground tissue having a number of scattered, closed, collateral vascular bundles (Fig. 8). These parenchymatous cells of the ground tissue, measuring 20-45-62-90 by 12-*41*-62-86 μ, are thin-walled, somewhat isodiametric with small intercellular spaces. A few of them are perforated (Fig. 9A). A number of mycorrhizae are present in the parenchymatous ground tissue (Figs. 9A, 11, o). Vascular bundles are enclosed in a sclerenchymatous sheath, having usual phloem elements in phloem region and vessels, tracheids, fibres and parenchyma in the xylem (Fig. 9B). The shape, thickening and pitting on the walls of different elements of the xylem are very similar to that of creeping stem (Fig. 11 a-n). However, their measurements are as follows:

Vessels 825-*1568-1749*-2805 by 25-33-50-66μ
Tracheids 116-347-825-1617 by 17-33-59-66μ
Fibres 214-908-*1634*-2244 by 16-25-33-50μ
Parenchyma 33-45-70-95 by 12-*17*-25-41μ

Pseudobulb: The transverse section of a pseudobulb shows a single layered epidermis (Figs. 12, 13A), composed of thick-walled, lignified cells, covered externally by a highly thickened cuticle. The cells measure 18-*21*-25 by 10-*12*-17μ. The epidermis is followed by parenchymatous ground tissue, 3 to 4 layers of which are slightly thick-walled and



Figs. 6-11 : Microscopical structure of the stem (creeping and aerial) of *Desmotrichum fimbriatum* Bl. Fig. 6. Diagrammatic T. S. of a portion of a mature creeping stem. Fig. 7. A, B, C : T. S. of details of a portion of Fig. 6. Fig. 8. Diagrammatic T. S. of a portion of the aerial stem. Fig. 9. A & B : T. S. of details of a portion of Fig. 8. Fig. 10. Isolated elements of creeping stem. a-d, fibres ; e-k, tracheids ; l-m, vessels ; n, a mycorrhiza present in parenchymatous tissue ; o-q, parenchyma. Fig. 11. Isolated elements of aerial stem ; a-d, fibres; e-i, tracheids ; j, vessel ; k-n, parenchyma ; o, mycorrhizae. CU, cuticle ; EPI, epidermis ; G. T, ground tissue ; G.T 1, ground tissue having thick walled parenchyma ; G. T 2, ground tissue having band of sclerenchyma ; MYC, mycorrhiza ; PAR, parenchyma ; P. PAR, pitted parenchyma ; PHL, phloem ; SCL, sclerenchyma ; SCL, SH, sclerenchymatous sheath ; V. B, vascular bundle ; XYL, xylem.

show lignin reaction, measuring 16-37-54-91 by 12-25-40-49μ. The rest of the cells are thin-walled measuring 32-*82-135*-287 by 32-*74-121*-168μ.

The vascular bundles, collateral and closed, are distributed throughout the ground tissue (Fig. 12). The bundles vary in size and are capped, on both the ends by sclerenchymatous fibres. The phloem faces towards the outerside and the xylem inner side of the bundle. The sclerenchymatous fibres capping on the phloem have narrower lumen than those capping the xylem (Fig. 13B).

The xylem elements are represented by vessels, tracheids, fibres and parenchyma and are much similar to those seen in case of root and stem (Fig. 14 a-l). However they differ in size, the measurement of which are as follows:

Vessels 536-*850*-1970 by 25-*50*-66μ
Tracheids 165-*446-940*-1353 by 16-*25-66*-90μ
Fibres 346-*957-1716*-2392 by 16-*25-33*-50μ

Leaf midrib:- The midrib, in a cross section, shows a depression on the ventral surface (Figs. 15A, 16A). The epidermis on both the surfaces are covered by thick cuticle and their cells are cubical to somewhat rectangular (Fig. 15A) measuring 12-24-28-32 by 12-*14-16*-20μ. The central region is occupied by large vascular bundle with xylem facing the ventral side and the phloem towards the dorsal side and is enclosed in a sheath of sclerenchymatous fibres. These fibres develop to much greater extent and almost cover the whole of the midrib, except 3 to 4 layers of mesophyll cells beneath the epidermis on the ventral side and one or two layers beneath the dorsal epidermis (Fig. 15A).

Lamina: The transverse section of the lamina shows a layer of epidermis on both the surfaces of the leaf, composed of slightly thick-walled, cubical to tangentially elongated cells (Figs. 15B, 15C), measuring 20-*25-29*-36 by 12-*14-20*-24μ and are covered externally with thick cuticle. The stomata (Fig. 17) are sunken and are present on the lower surface only. They are mixed type cruciferous and graminaceous (Fig. 18). Trichomes are absent on both the surfaces of leaf. The mesophyll is not differentiated in palisade and spongy tissue (Fig. 15B) and is composed of thin-walled more or less circular, irregular to slightly elliptical parenchyma cells measuring 33-*49-82*-112 by 21-*29-45*-68μ. Towards the margin, these cells are gradually reduced in size (Fig. 15C).

The mesophyll is traversed by a number of veins having same structure as the midrib (Figs. 16A, 16B, 15B, 15C). In case of small veins the vascular tissue is much reduced being represented by a few cells only surrounded by a sheath of sclerenchymatous fibres.

The isolated vessels (Fig. 19 i) are very long having transverse or sometimes slightly oblique opening at the ends. They have scalariform and spiral thickening on their walls and measure 640-*825*-2050 by 25-*40*-60μ. Tracheids (Figs. 19 e, f) are long, with pointed or flattened ends. They have bordered pits on their walls and measure 108-*495*-850 by 25-*33*-41μ. Fibres (Figs. 19 g, h) are usually long with both the ends pointed or one end slightly notched and only a few bordered pits are present. They measure 208-*940-1402*-1650 by 16-*24*-32 μ. The parenchyma (Figs. 19 a-d) are thick-walled with bordered pits and sometimes they are reticulately thickened.

Quantitative values: The study of vein-islet and vein termination number is not possible as the drug being a member of Orchidaceae, has parallel, multicostate venation in the leaves, so vein-islet and vein ending could not be marked. The mesophyll tissue of the leaf is not differentiated into palisade and spongy tissue hence, in author's view the study of palisade ratio is not justified in this case. Stomatal indices of lower surface of three different mature leaves have been determined and are noted in the table I.

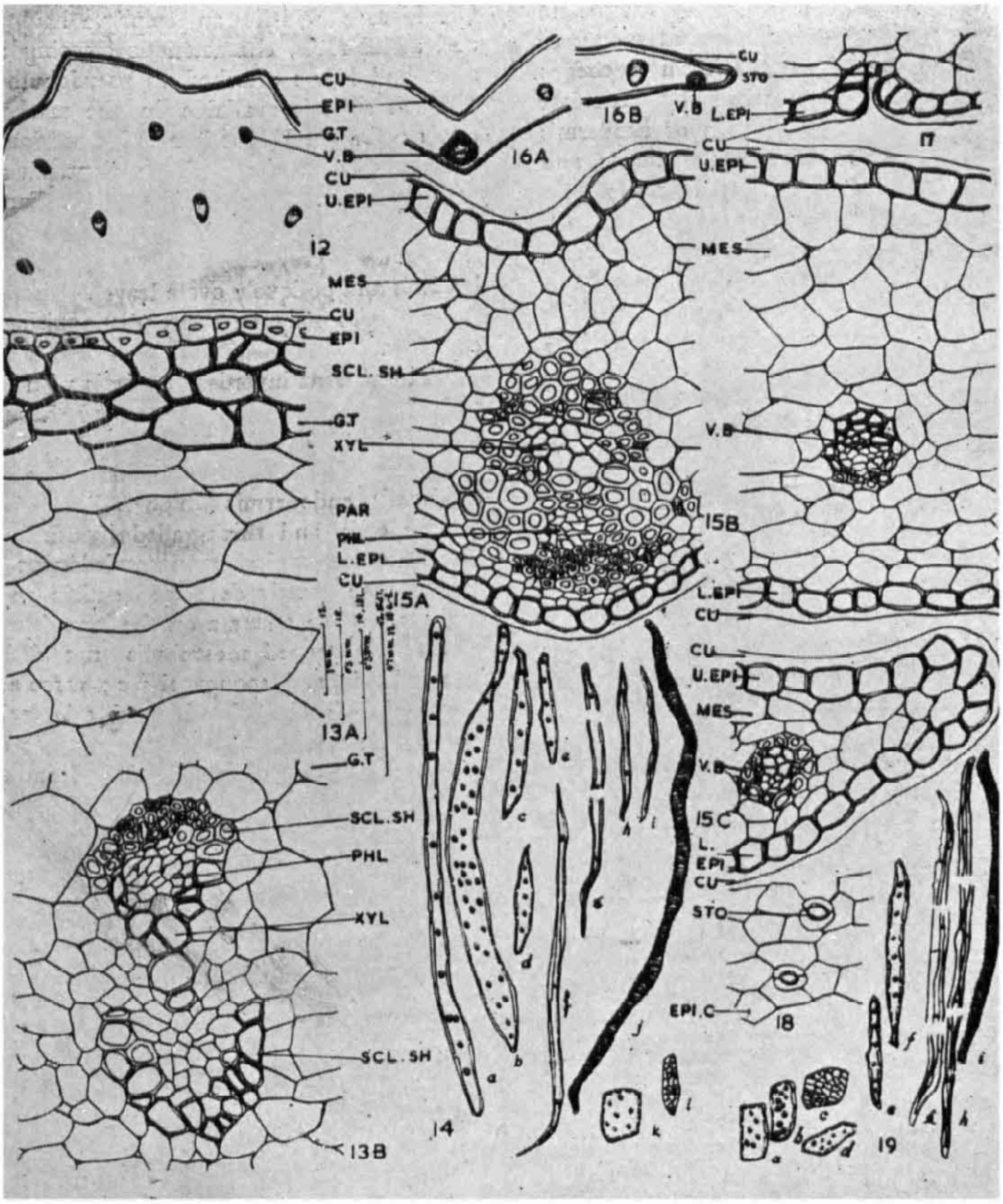
TABLE I

Stomatal index of lower surface of three different mature leaves of *Desmotrichum fimbriatum* Bl.

Surface of leaf	LOCATION				
	Base	Middle	Apex	Range of variation	Mean value per leaf
Lower	6.8	9.7	11.4	6 to 12	9.3
	8.6	10.1	12.0	8 to 12	10.2
	8.5	10.4	12.0	6 to 12	9.6
				Mean value	9.72

EXAMINATION OF DRUG POWDER

The colour of the powder is yellowish brown. The histological elements to be observed microscopically include fragments of epidermis of leaf, stem and pseudobulb consisting of almost elongated cells, covered externally by yellow coloured cuticle and their walls being thick and lignified.



Figs. 12-19 : Microscopical structure of pseudobulb and leaf.

Fig. 12. Diagrammatic T. S. of a portion of pseudobulb. Fig. 13. A & B : T. S. of details of a portion of Fig. 12. Fig. 14. Isolated elements of Pseudobulb. a-e, tracheids ; f-i, fibres ; j, vessel ; k-l, parenchyma. Fig. 15. Details of T. S. of a portion of leaf. 15A : Midrib region. 15B : A portion of lamina. 15C : Marginal region. Fig. 16. Diagrammatic T. S. of a portion of leaf. 16A : Midrib region. 16B : A portion of lamina and marginal region. Fig. 17. T. S. of lower epidermis showing a sunken stomata. Fig. 18. Lower epidermal cells and stomata in surface view. Fig. 19. Isolated elements of the leaf ; a-d, parenchyma cells ; e-f, tracheids ; g-h, fibres ; i, vessels ; CU, cuticle ; EPI, epidermis ; EPI.C, epidermal cell ; G. T, ground tissue ; L. EPI, lower epidermis ; MES, mesophyll ; PAR, parenchyma ; PHL, phloem ; SCL. SH, sclerenchymatous sheath ; STO, stoma ; U. EPI, upper epidermis ; V. B, vascular bundle ; XYL, xylem.

Lower epidermis of the leaf is marked by the presence of oval stomata which are graminaceous to cruciferous type; fibres either in isolated groups or associated with spiral to scalariform tracheae; groups of velamen cells marked by reticulate thickening and lignified walls; cells of exodermis having characteristic sclereid like appearance and spindle shaped, fibrous pith cells of root; fragments of septate mycelia; and numerous irregular fragments of unlignified parenchyma of the ground tissue.

Fluorescence analysis: The powder of the whole plant of *Desmotrichum fimbriatum* was examined under ultraviolet light, according to the methods described by Chase and Pratt (1949) and the fluorescence characters are recorded in the table II.

TABLE II

TREATMENT	FLUORESCENCE
Powder as such	Golden Yellow
Powder mounted in nitrocellulose	Violet
Powder treated with 1N NaOH in Methanol.	Yellowish Green
Powder treated with 1N.NaOH in Methanol, and mounted in nitrocellulose.	Bluish Green

DETERMINATION OF PHYSICAL CONSTANTS

Total ash, acid insoluble ash and water and alcohol soluble extractives of the whole drug were determined by the method given in Pharmacopoeia of India (1966). The findings are tabulated in the table III.

TABLE III

	Percentage of value*
Total ash	5.097
Acid insoluble ash	0.893
Water soluble extractive	15.395
Alcohol soluble extractive	15.493

*Values are average of three determinations.

DISCUSSION

In Ayurvedic literature three taxonomically much different species, as mentioned earlier, are named as *Jivanti* in Sanskrit. In this part of the country, both *Desmotrichum fimbriatum* Bl. and *Leptadenia reticulata* Wight are equally administered on account of their similarity of uses, as both of them are supposed to be stimulant and tonic, differing from the *Trema orientalis* Bl. which is employed in epilepsy.

Desmotrichum fimbriatum Bl. belongs to family Orchidaceae and is an epiphyte having clinging and aerial roots, characteristic creeping and aerial stem and leaves attached to pseudobulbs. Whole plant as such is available in the market. *Leptadenia reticulata* Wight is a twiner of family Asclepiadaceae. Cut pieces of the plant parts are sold in the market. *Trema orientalis* Bl. (Family—Urticaceae) is a short lived, evergreen tree with stem having dark grey coloured thin bark with many lenticels and obliquely ovate leaves. Therefore these three species may be easily distinguished macroscopically.

The present investigation deals with the macro- and the microscopical features of *Desmotrichum fimbriatum* Bl. The most important diagnostic characters of the root are the presence of velamen, exodermis, endodermis which is lignified except at passage cells, and thick-walled lignified pith cells. The stem has typical monocotyledonous structure. Leaves have greatly developed cuticle on both the surfaces, sunken stomata on the lower surface only, compactly arranged mesophylls not differentiated into palisade and spongy tissue; vascular bundles surrounded by heavily lignified sclerenchymatous sheath. These are the salient diagnostic characters which may differentiate this plant from other two species.

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